US008681144B2

(12) **United States Patent**
Bolger et al.

(10) **Patent No.: US 8,681,144 B2**
(45) **Date of Patent: Mar. 25, 2014**

(54) **PRIORITIZED RENDERING OF OBJECTS IN A VIRTUAL UNIVERSE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 510 days.

(21) Appl. No.: **12/339,418**

(22) Filed: **Dec. 19, 2008**

(65) **Prior Publication Data**

US 2010/0156899 A1 Jun. 24, 2010

(51) **Int. Cl.**
G06T 17/00 (2006.01)

(52) **U.S. Cl.**
USPC **345/419**; 715/850; 707/655

(58) **Field of Classification Search**
USPC 345/419
See application file for complete search history.

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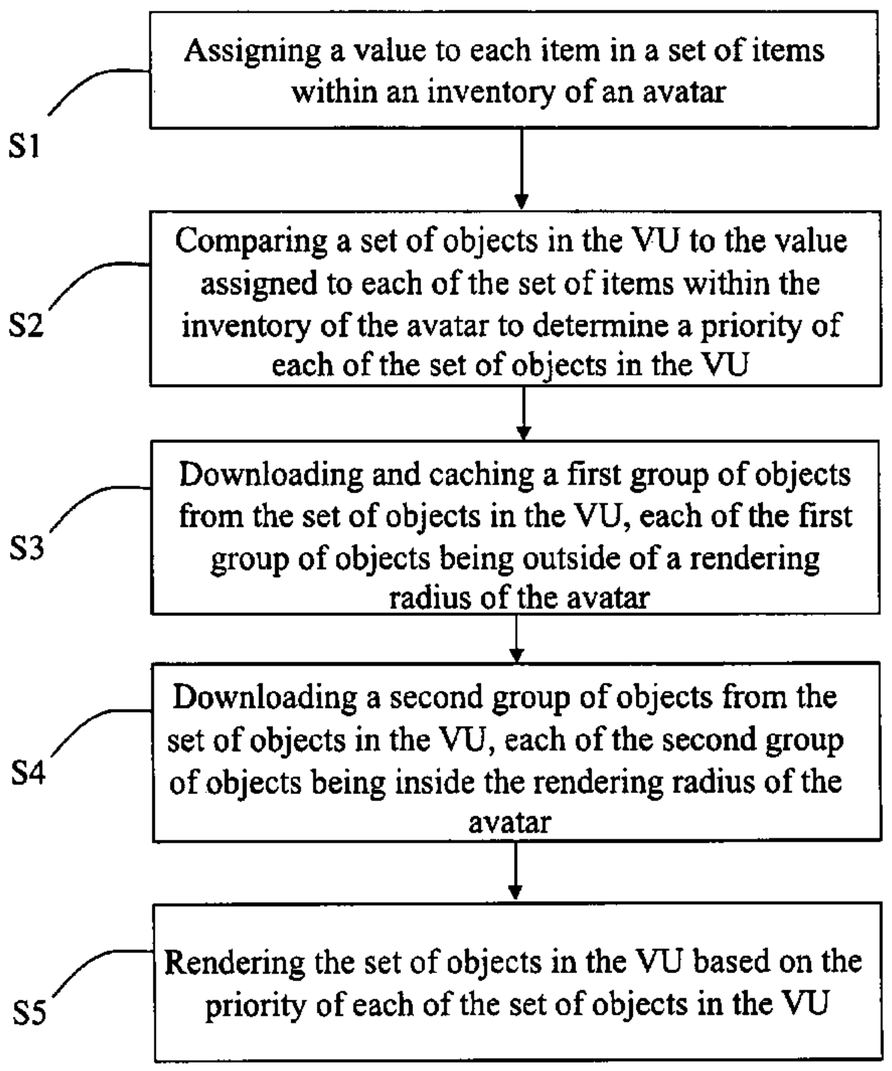
(57) **ABSTRACT**

An invention for prioritized rendering of objects in a virtual universe is provided. In one embodiment, there is a prioritization tool including a value component configured to assign a value to each of a set of items within an inventory of an avatar. A priority component is configured to compare a set of objects in the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the virtual universe. A rendering component is configured to render the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

16 Claims, 7 Drawing Sheets



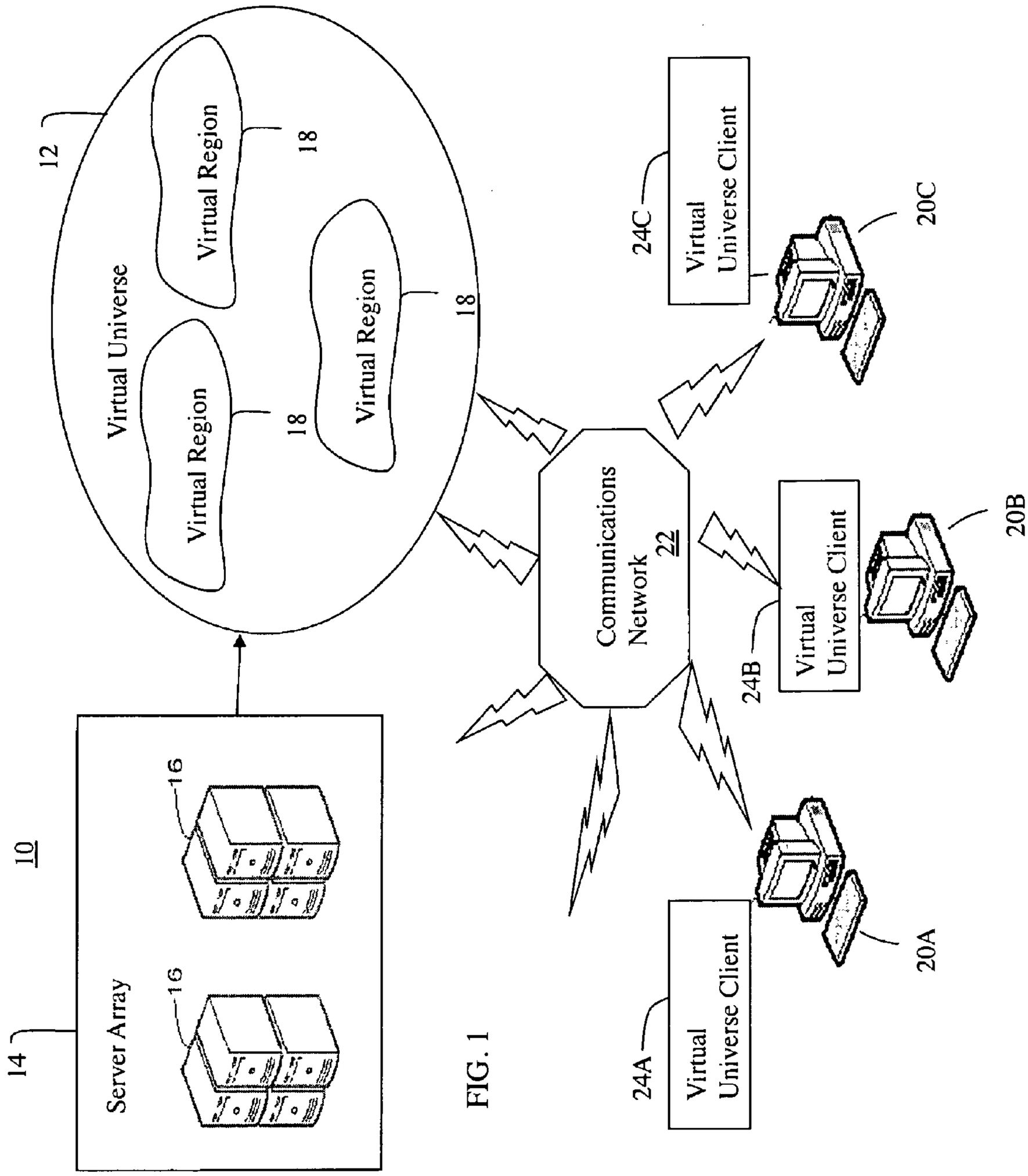

10
14
Server Array
16
16
12
Virtual Universe
Virtual Region
Virtual Region
18
18
Virtual Region
18
Communications Network
22
24A
Virtual Universe Client
24B
Virtual Universe Client
24C
Virtual Universe Client
20A
20B
20C

FIG. 1

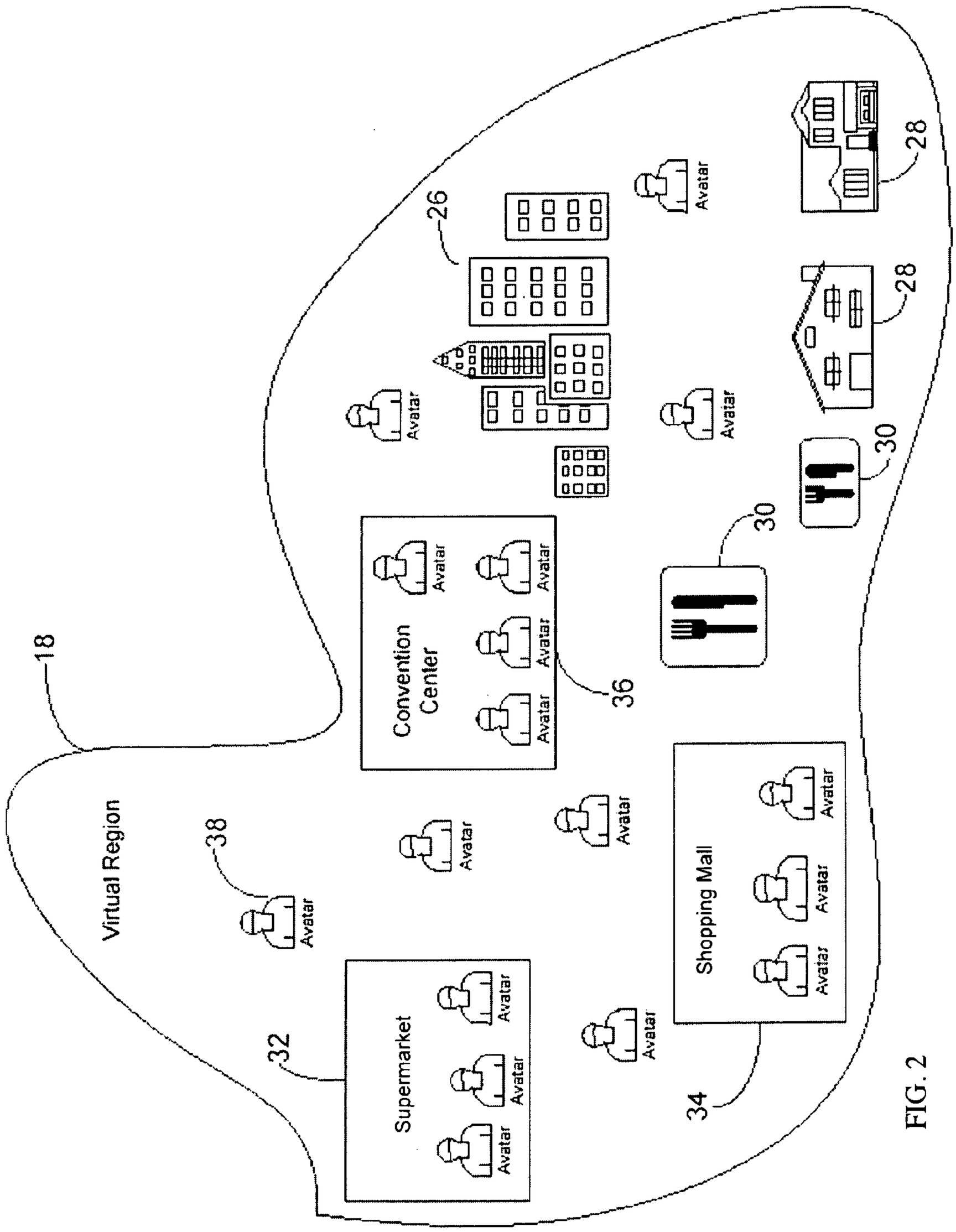

18
Virtual Region
26
28
30
32
34
36
38
Avatar
Convention Center
Supermarket
Shopping Mall

FIG. 2

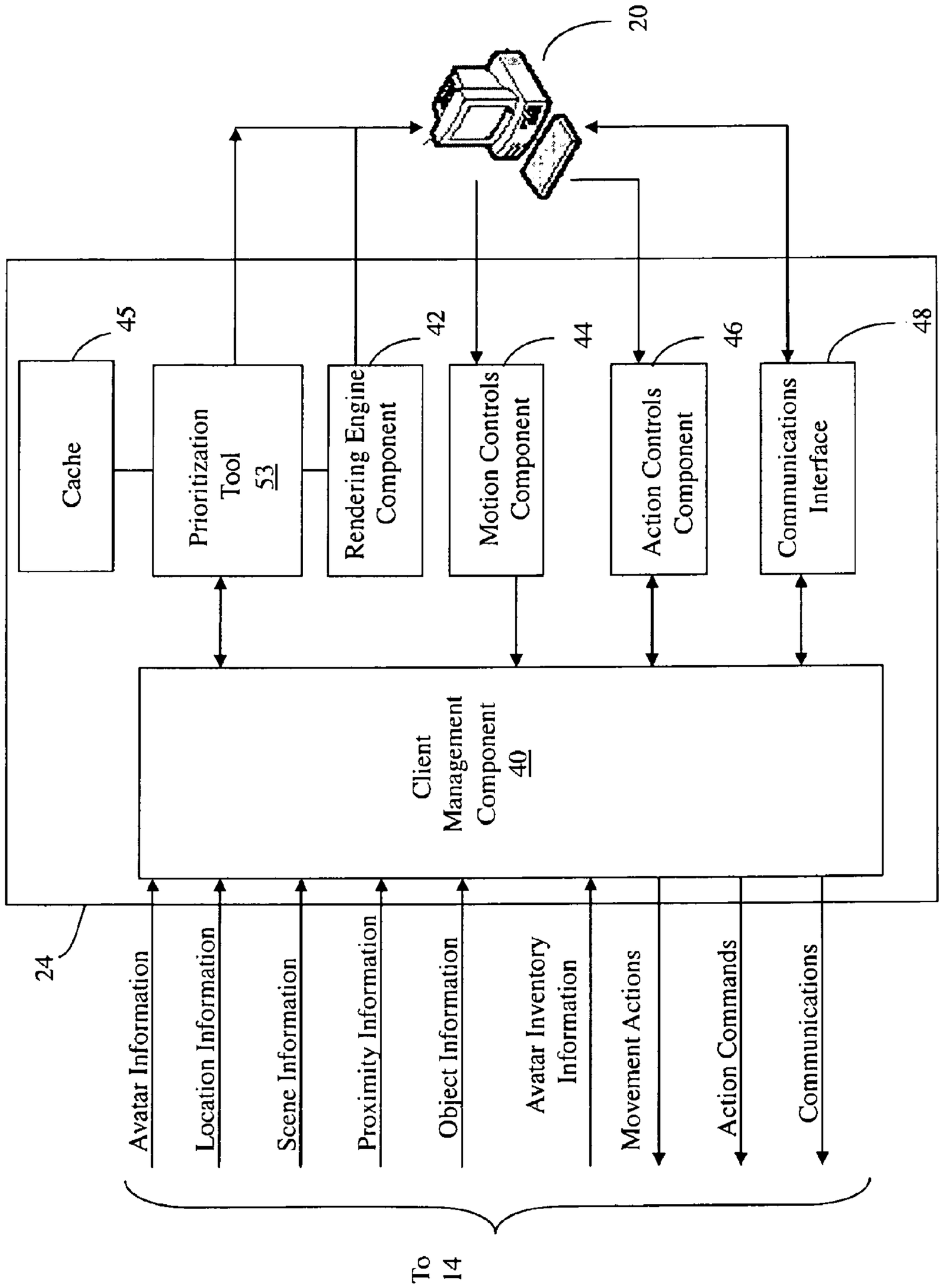

20
Cache
45
Prioritization Tool 53
Rendering Engine Component
42
Motion Controls Component
44
Action Controls Component
46
Communications Interface
48
Client Management Component 40
24
Avatar Information
Location Information
Scene Information
Proximity Information
Object Information
Avatar Inventory Information
Movement Actions
Action Commands
Communications
To 14

FIG. 3

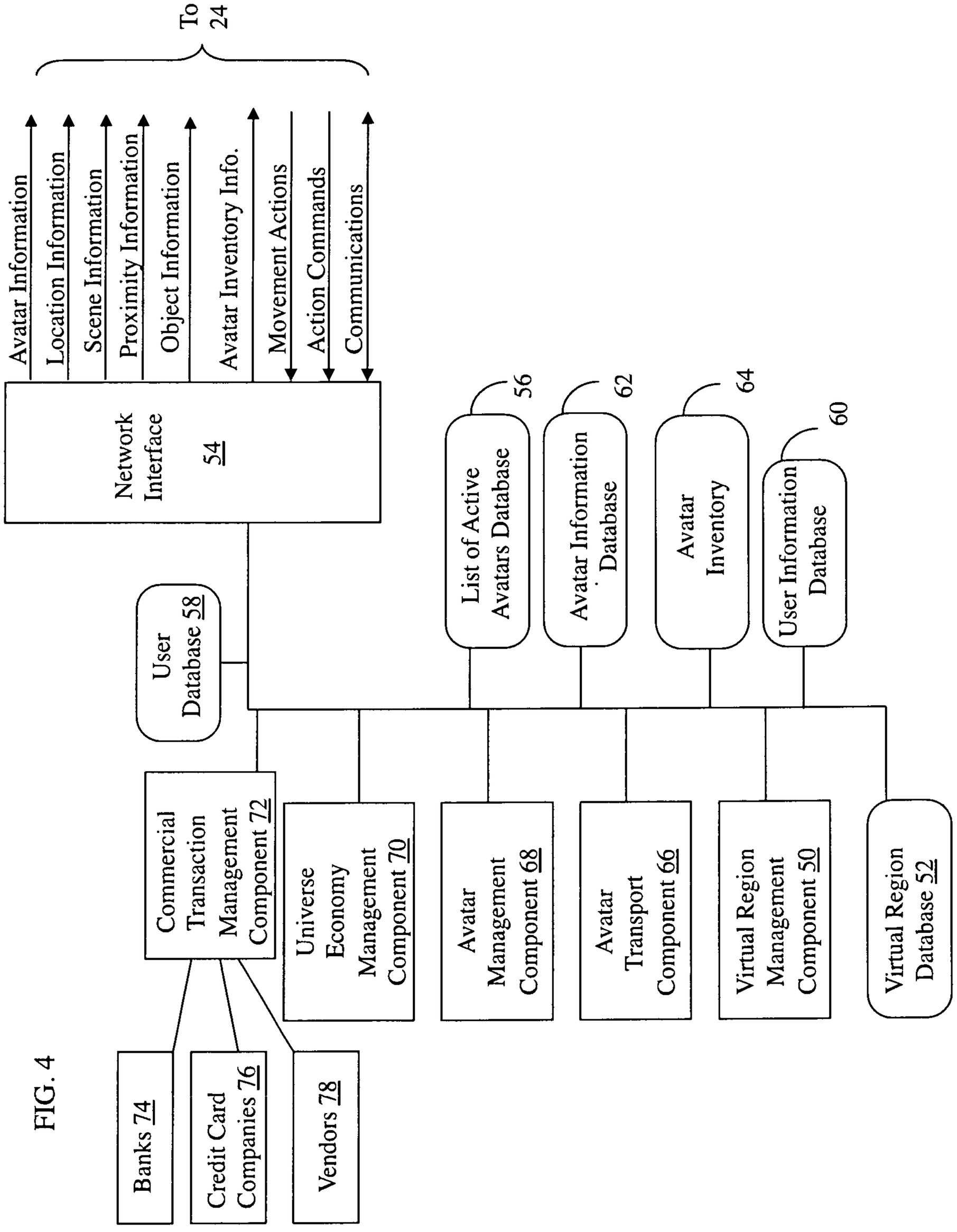

To 24
Avatar Information
Location Information
Scene Information
Proximity Information
Object Information
Avatar Inventory Info.
Movement Actions
Action Commands
Communications
Network Interface 54
User Database 58
List of Active Avatars Database 56
Avatar Information Database 62
Avatar Inventory 64
User Information Database 60
Commercial Transaction Management Component 72
Universe Economy Management Component 70
Avatar Management Component 68
Avatar Transport Component 66
Virtual Region Management Component 50
Virtual Region Database 52
Banks 74
Credit Card Companies 76
Vendors 78

FIG. 4

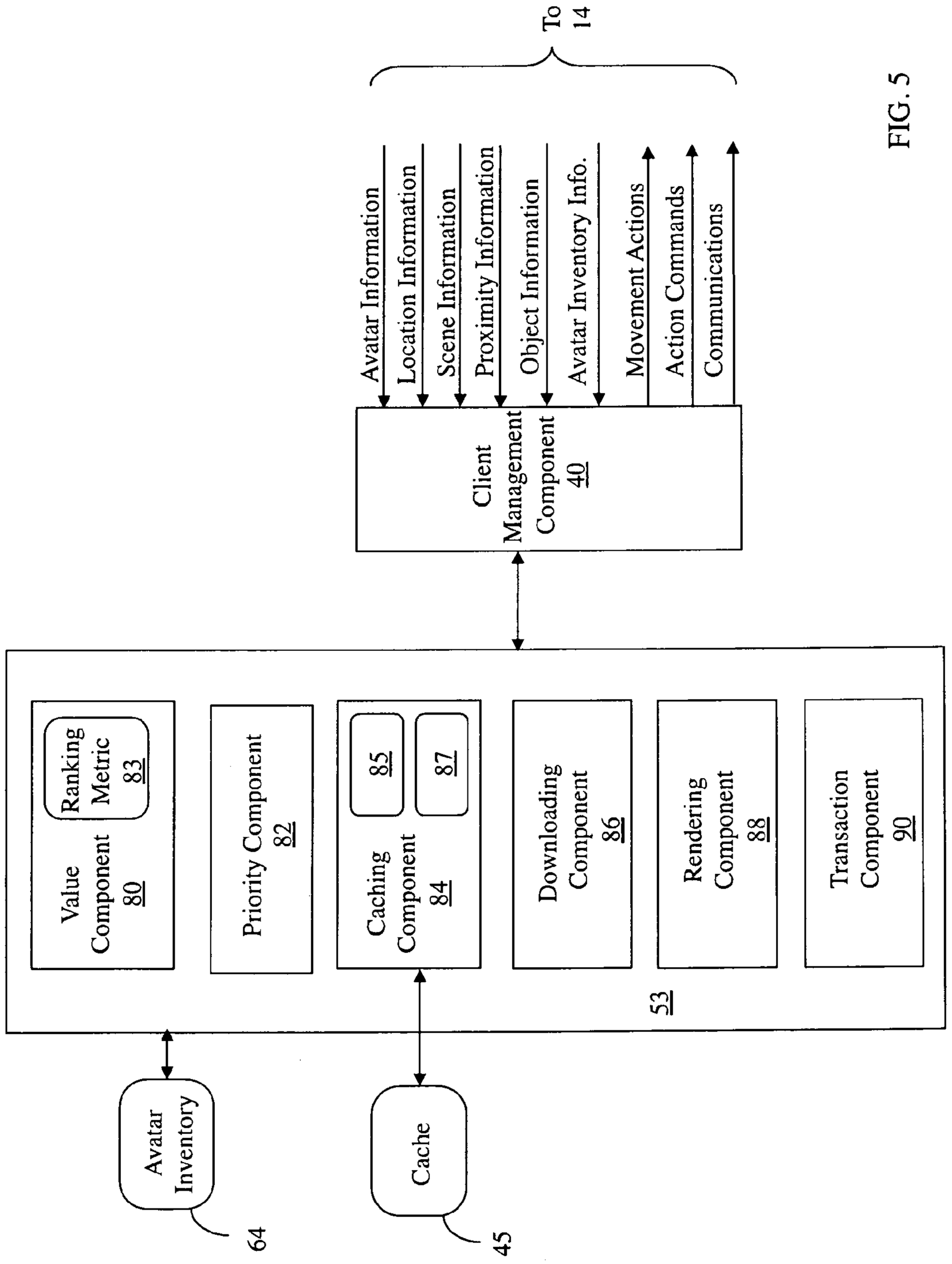

To 14
Avatar Information
Location Information
Scene Information
Proximity Information
Object Information
Avatar Inventory Info.
Movement Actions
Action Commands
Communications
Client Management Component 40
Value Component 80
Ranking Metric 83
Priority Component 82
Caching Component 84
85
87
Downloading Component 86
Rendering Component 88
Transaction Component 90
53
Avatar Inventory
64
Cache
45

FIG. 5

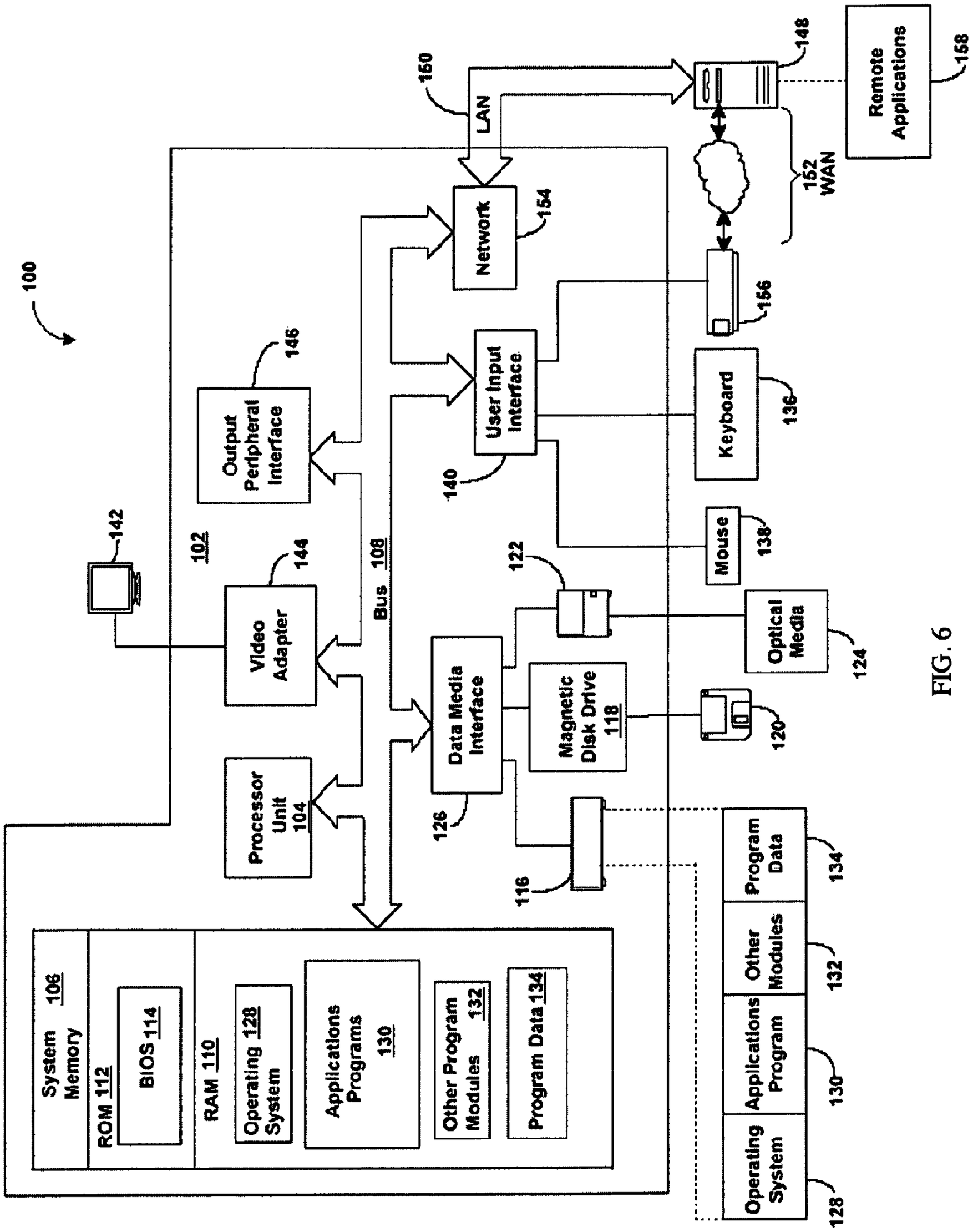

100
102
Processor Unit 104
System Memory 106
ROM 112
BIOS 114
RAM 110
Operating System 128
Applications Programs 130
Other Program Modules 132
Program Data 134
Bus 108
Video Adapter 144
142
Output Peripheral Interface 146
Data Media Interface 126
Magnetic Disk Drive 118
User Input Interface 140
Keyboard 136
Mouse 138
Optical Media 124
122
120
116
Network 154
LAN 150
WAN 152
148
Remote Applications 158
156
Program Data 134
Other Modules 132
Applications Program 130
Operating System 128

FIG. 6

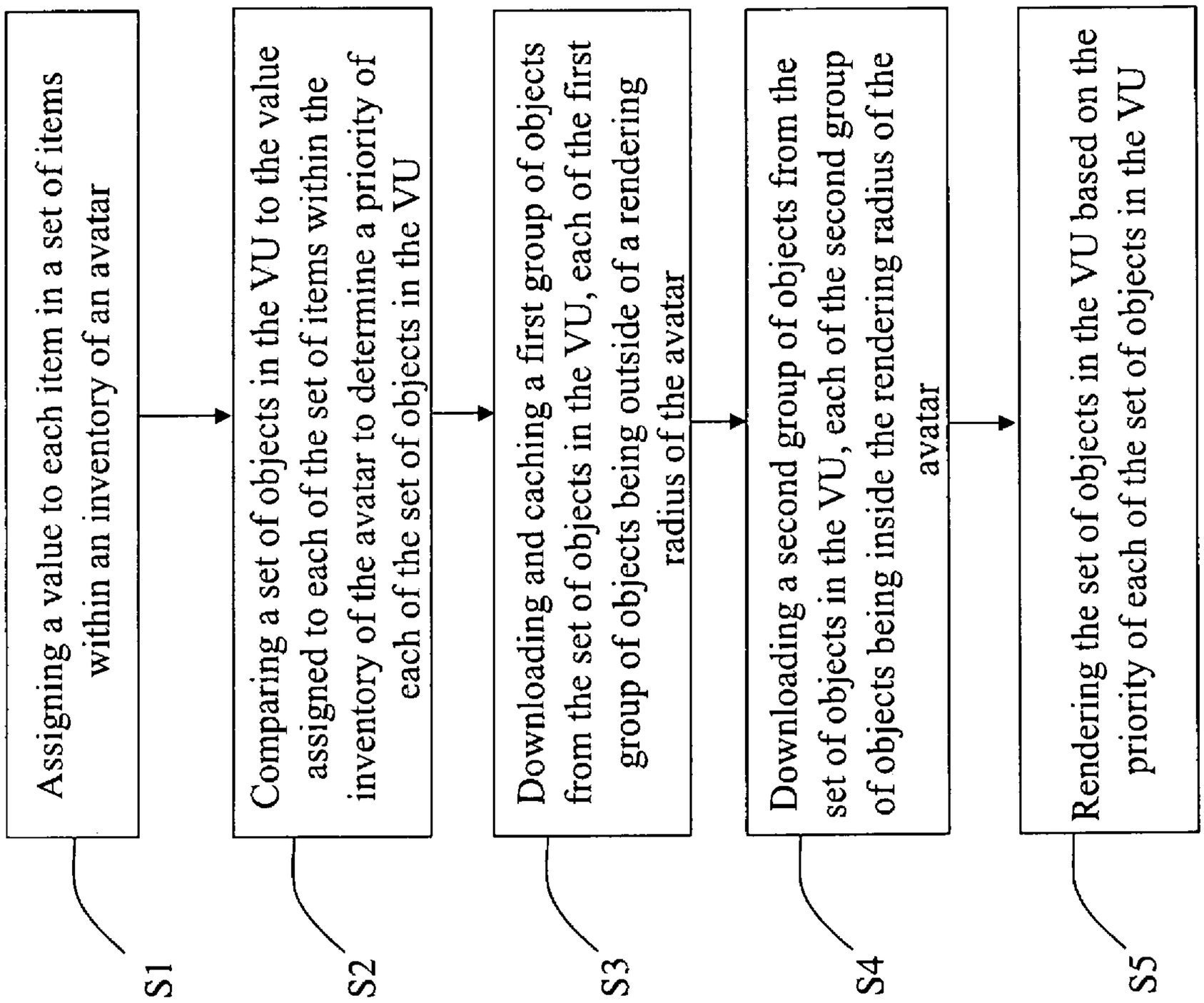

S1
Assigning a value to each item in a set of items within an inventory of an avatar
S2
Comparing a set of objects in the VU to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the VU
S3
Downloading and caching a first group of objects from the set of objects in the VU, each of the first group of objects being outside of a rendering radius of the avatar
S4
Downloading a second group of objects from the set of objects in the VU, each of the second group of objects being inside the rendering radius of the avatar
S5
Rendering the set of objects in the VU based on the priority of each of the set of objects in the VU

FIG. 7

PRIORITIZED RENDERING OF OBJECTS IN A VIRTUAL UNIVERSE

FIELD OF THE INVENTION

This invention relates generally to virtual universes and more specifically to the rendering of objects in a virtual universe.

BACKGROUND OF THE INVENTION

Virtual universes or virtual worlds are computer-based simulated environments intended for its users or residents to inhabit and interact via avatars, which are personas or representations of the users of the virtual universes and generally take the form of two-dimensional or three-dimensional human or fantastical representations of a person's self. These types of virtual universes are now most common in massively multiplayer online games, such as Second Life®, which is a trademark of Linden Research Inc. in the United States. Avatars in these types of virtual universes, which can number well over a million, have a wide range of business and social experiences.

Many regions within a virtual universe contain complex environments with large numbers of objects. Prior art virtual universes only cache items worn by or attached to an avatar, or those items within a predefined proximity. Therefore, a user may experience delays when traversing regions, as objects are downloaded upon entrance or while in transit to a region.

In the prior art, after an avatar enters a region, all items surrounding the avatar must be downloaded from a server. The time to display an object varies by the size of the object and is constrained by download speed to the virtual universe client, resulting in potentially delayed rendering of objects. Since, in most cases an avatar may only interact with objects that are located within a predefined proximity, prior-art caching mechanisms begin to download objects to the local cache only after the avatar enters a region.

However, caching or pre-fetching objects by proximity does not provide an optimal experience for most users. It is common for an avatar to be first presented with objects that are not the user's primary interest. The user must wait while objects of limited interest are retrieved, cached, and processed before the region is rendered.

SUMMARY OF THE INVENTION

In one embodiment, there is a method for prioritized rendering of objects in a virtual universe. The method comprises: assigning a value to each of a set of items within an inventory of an avatar; comparing a set of objects in the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the virtual universe; and rendering the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

In a second embodiment, there is a computer system for providing prioritized rendering of objects in a virtual universe. In this embodiment, the system comprises at least one processing unit and memory operably associated with the at least one processing unit. A prioritization tool is storable in memory and executable by the at least one processing unit. The prioritization tool comprises a value component configured to assign a value to each of a set of items within an inventory of an avatar; a priority component configured to compare a set of objects in the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the virtual universe; and a rendering component configured to render the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

In a third embodiment, there is a computer-readable medium storing computer instructions, which when executed, enables a computer system to provide prioritized rendering of objects in a virtual universe. In this embodiment, the computer instructions comprise: assigning a value to each of a set of items within an inventory of an avatar; comparing a set of objects in the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the virtual universe; and rendering the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

In a fourth embodiment, there is a method for deploying a prioritization tool for use in a computer system that provides prioritized rendering of objects in a virtual universe. In this embodiment, a computer infrastructure is provided and is operable to: assign a value to each of a set of items within an inventory of an avatar; compare a set of objects in the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the virtual universe; and render the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a high-level schematic diagram showing a networking environment for providing a virtual universe according to one embodiment of this invention;

FIG. **2** shows a more detailed view of a virtual region shown in the virtual universe of FIG. **1**;

FIG. **3** shows a more detailed view of the virtual universe client shown in FIG. **1**;

FIG. **4** shows a more detailed view of some of the functionalities provided by the server array shown in FIG. **1**;

FIG. **5** shows a prioritized rendering tool according to one embodiment of this invention that operates in the environment shown in FIG. **1**;

FIG. **6** shows a schematic of an exemplary computing environment in which elements of the networking environment shown in FIG. **1** may operate; and

FIG. **7** shows a flow diagram of a method for prioritized rendering of objects in a virtual universe according to one embodiment of the invention.

The drawings are not necessarily to scale. The drawings are merely schematic representations, not intended to portray specific parameters of the invention. The drawings are intended to depict only typical embodiments of the invention, and therefore should not be considered as limiting the scope of the invention. In the drawings, like numbering represents like elements.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of this invention are directed to prioritized rendering of objects in a virtual universe, such that wait times for the rendering of objects are reduced. In these embodiments, a prioritization tool provides the capability to render the objects in the virtual universe based on a value assigned to each of a set (i.e., one or more) of items within an inventory of an avatar, such that objects in the virtual universe that are more likely to be of interest to the user are rendered first. To accomplish this, the prioritization tool compares a set of

objects in the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the virtual universe. The prioritization tool then renders the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

FIG. **1** shows a high-level schematic diagram showing a networking environment **10** for providing a virtual universe **12** according to one embodiment of this invention in which a service for prioritized rendering of objects can be utilized. As shown in FIG. **1**, the networking environment **10** comprises a server array or grid **14** comprising a plurality of servers **16** each responsible for managing a portion of virtual real estate within virtual universe **12**. A virtual universe provided by a multiplayer online game, for example, can employ thousands of servers to manage all of the virtual real estate. The virtual content of the virtual real estate that is managed by each of servers **16** within server array **14** shows up in virtual universe **12** as a virtual region **18** made up of objects, textures and scripts. Like the real-world, each virtual region **18** within virtual universe **12** comprises a landscape having objects, such as buildings, stores, clubs, sporting arenas, parks, beaches, cities and towns all created by residents of the universe that are represented by avatars. These examples of objects and virtual content are only illustrative of some things that may be found in a virtual region and are not limiting. Furthermore, the number of virtual regions **18** shown in FIG. **1** is only for illustration purposes and those skilled in the art will recognize that there may be many more regions found in a typical virtual universe, or even only one region in a small virtual universe. FIG. **1** also shows that users operating computers **20**A-**20**C (hereinafter referred generally as **20**) interact with virtual universe **12** through a communication network **22** via virtual universe clients **24**A-**24**C (hereinafter referred generally as **24**) that reside in the computers **20**, respectively. Below are further details of virtual universe **12**, server array **14**, and virtual universe client **24**.

FIG. **2** shows a more detailed view of what one virtual region **18** shown in virtual universe **12** of FIG. **1** may comprise. As an example, virtual region **18** shown in FIG. **2** comprises objects, including: a downtown office center **26**, homes **28**, restaurants **30**, a supermarket **32** and a shopping mall **34** for shopping, and a convention center **36** for meetings and various conventions. Residents or avatars **38**, which as mentioned above, are personas or representations of the users of the virtual universe, roam all about the virtual region by walking, driving, flying or even by teleportation or transportation, which is essentially moving through space from one point to another, more or less instantaneously. These examples of objects in virtual region **18** shown in FIG. **2** are only illustrative of some things that may be found in a virtual region and those skilled in the art will recognize that these regions can have many more objects that can be found in a real-life universe as well as things that do not presently exist in real life.

FIG. **3** shows a more detailed view of virtual universe client **24** shown in FIG. **1**. Virtual universe client **24**, which enables users to interact with virtual universe **12**, comprises a client management component **40**, which manages actions, movements and communications made by a user through computer **20**, and information received from the virtual universe through server array **14**. A rendering engine component **42** enables the user of computer **20** to visualize his or her avatar within the surroundings of the particular region of virtual universe **12** that the avatar is presently located. Rendering is the process of producing the pixels of an image from a higher-level description of its components. Additionally, rendering is the process of generating an image from a model, by means of computer programs. The model is a description of three-dimensional objects in a strictly defined language or data structure. Models contain geometry, viewpoint, texture, lighting, and shading information.

A motion controls component **44** enables the user to make movements through the virtual universe. In one embodiment, movements through the virtual universe can include, for example, gestures, postures, walking, running, driving, flying, etc. An action controls component **46** enables the user to perform actions in the virtual universe, such as buying items for his or her avatar or even for their real-life selves, building homes, planting gardens, etc., as well as changing the appearance of their avatar. These actions are only illustrative of some possible actions that a user can perform in the virtual universe and are not limiting. A communications interface **48** enables a user to communicate with other users of virtual universe **12** through modalities such as chatting, instant messaging, gesturing, talking and electronic mail (e-mail).

Virtual universe client **24** further comprises a prioritization tool **53** for prioritized rendering of objects within the virtual universe, as described herein. In this embodiment, prioritization tool **53** resides on the same computer system as virtual universe client **24**. However, it can be appreciated that in other embodiments, prioritization tool **53** may reside on servers **16**, or reside on separate computers in direct communication with the virtual universe servers **16** and virtual universe clients **24**.

A cache **45** is also provided for storing objects. As used herein, cache **45** is defined as a temporary storage area where frequently accessed data can be stored for rapid access. The data may be a collection of data duplicating original values stored elsewhere or computer earlier. Once the data is stored in the cache, future use may access the cached copy rather than re-fetching or re-computing the original data, resulting in a lower average access time. As will be further described below, objects can be pre-fetched by prioritization tool **53** and sent to cache **45** to reduce delays in the rendering of objects.

FIG. **3** shows the various types of information received by client management component **40** from the virtual universe through server array **14**. In particular, client management component **40** receives location information about the area that the user's avatar is near (e.g., what region or land he or she is in) as well as scene information, including information about objects within a given region or area of the virtual universe. Client management component **40** also receives information about items within an avatar inventory **64** (FIG. **4**).

Client management component **40** also receives proximity information, which contains information on what the user's avatar is near, and object information, which includes information about the objects in the virtual universe inside and outside of a rendering radius of an avatar. FIG. **3** also shows the movement actions and action commands that are generated by the user and sent to the server array via client management component **40**, as well as the communications that can be sent to the users of other avatars within the virtual universe.

FIG. **4** shows a more detailed view of some of the functionalities provided by server array **14** shown in FIG. **1**. In particular, FIG. **4** shows a virtual region management component **50** that manages a virtual section within the virtual universe. Virtual region management component **50** manages what happens in a particular region, such as the type of landscape in that region, the number of homes, commercial zones, boutiques, streets, parks, restaurants, etc. Those

skilled in the art will recognize that virtual region management component **50** can manage many facets within the virtual region.

As shown in FIG. **4**, there are several different databases for storing information. In particular, a virtual region database **52** stores information on all of the specifics in virtual region **18** that virtual region management component **50** is managing. Specifically, virtual region database **52** contains metadata information about the objects, texts and scripts associated with the virtual content in virtual region **18**. List of active avatars database **56** contains a list of all the avatars that are online in virtual universe **12**. Databases **58** and **60** contain information on the actual human users of virtual universe **12**. In one embodiment, user database **58** contains general information on the users such as names, addresses, interests, ages, etc., while user information database **60** contains more sensitive information on the users such as email addresses, and billing information (e.g., credit card information) for taking part in transactions.

Databases **62** and **64** contain information on the avatars of the users that reside in virtual universe **12**. Specifically, avatar information database **62** contains information such as all of the avatars that a user may have, the profile of each avatar, and avatar characteristics (e.g., appearance, voice and movement features), while avatar inventory **64** is a database that contains an inventory listing of the items within the inventory of each avatar, such as hair pieces, weapons, jewelry, houses, cars, sporting equipment, appearance, attire, etc. As virtual universes become more mainstream within business settings, it is conceivable that users may want to have public and private inventories for their avatar in order to protect unwanted discovery of confidential and proprietary information. Therefore, in one embodiment, avatar information database **62** may contain public and private inventories in order to account for various business and social encounters that need to be shielded from unauthorized parties. Those skilled in the art will recognize that databases **56-64** may contain additional information if desired. Although the above information is shown in FIG. **4** as being stored in separate databases, those skilled in the art will recognize that other database configurations and other means of storing information can be utilized.

FIG. **4** shows a network interface **54** that enables server array **14** to interact with virtual universe client **24** residing on computer **20**. In particular, the network interface **54** communicates avatar, location, scene, proximity, script, object, and avatar inventory information to the user through virtual universe client **24**. The network interface receives movement and action commands, as well as communications from the user via virtual universe client **24**.

An avatar transport component **66** enables users to transport, which as mentioned above, allows avatars to transport through space from one point to another point, more or less instantaneously. Moving from one virtual region to a second virtual region requires the objects in the second region to be rendered as quickly as possible. As will be further described below, prioritization tool **53** of the present invention is configured to render the objects in the second region that are most likely to be important to the avatar before rendering objects that are less likely to be important to the avatar based on the items in the avatar's inventory.

An avatar management component **68** keeps track of what avatars are doing while in the virtual universe. For example, avatar management component **68** can track where each avatar is presently located in the virtual universe, as well as what activities the avatars are performing or may perform next. An illustrative but non-exhaustive list of activities can include shopping, eating, talking, recreating, etc.

Because a typical virtual universe has a vibrant economy, server array **14** has functionalities that are configured to manage the economy. In particular, a universe economy management component **70** manages transactions that occur within the virtual universe between avatars. In one embodiment, virtual universe **12** has its own currency that users pay for with real-life money. The users can then take part in commercial transactions for their avatars through universe economy management component **70**. For example, an avatar might want to pay for a service that provides this prioritized rendering. In this case, the avatar would make the purchase of this service using the virtual universe currency. In some instances, the user may want to take part in a commercial transaction that benefits him or her and not an avatar. In this case, a commercial transaction management component **72** allows the user to participate in the transaction. For example, while walking around a commercial zone, a user may see a pair of shoes that he or she would like for themselves and not his/her avatar. In order to fulfill this type of transaction and others similarly related, commercial transaction management component **72** interacts with banks **74**, credit card companies **76** and vendors **78**.

Referring now to FIG. **5**, prioritization tool **53** of the present invention will be described in further detail. Specifically, prioritization tool **53** provides the capability to compare a number of objects in virtual universe **12** to the items within an inventory of avatar **38**, such as avatar inventory **64**, to render objects that are more likely to be important to avatar **38**. To accomplish this, prioritization tool **53** comprises a value component **80** configured to assign a value to each of a set of items within the inventory of avatar **38**. Value component **80** analyzes metadata associated with each of the set of items in avatar inventory **64**, and ranks each of the set of items in the inventory based on the analyzed metadata. The ranking of terms within inventory metadata may be composed of multiple discrete rankings. In an exemplary embodiment, the ranking of each term is dictated by at least one of the following: a number of occurrences of each term in the inventory metadata, or an acquisition date of each term.

In one embodiment, value component **80** includes a ranking metric **83** for determining the value of each item in avatar inventory **64**. Referring to the example described below, one possible ranking metric for implementing the described ranking method is shown. In Table 1, a term's rank is increased by the amount specified in the table for every occurrence within inventory metadata. In this example, the acquisition date predominately determines the rank of each term.

TABLE 1

Acquired Date	Current month	Previous month	. . .	Eleven months ago	Twelve months ago or more
Rank Increase	12	11	. . .	2	1

Consider Table 2 below, which is a depiction of a user's inventory according to this example.

TABLE 2

Metadata Terms	Acquisition date
Football, NFL ®	September 2007
Jersey, NFL ®	July 2007
Legal Document	January 2007
Legal Document	January 2007
Legal Document	January 2007

Using the information depicted in Table 1 and Table 2, a third table is generated which contains the ranking order for metadata terms. The calculations assume the calculation month is September, 2007.

TABLE 3

Rank	Term	Ranking order calculation
1	NFL ®	12 + 10 = 22
2	Legal Document	5 + 5 + 5 = 15
3	Football	12 = 12
4	Jersey	10 = 10

As shown above, the first term (NFL®) occurs twice in the sample inventory. (NFL® is a trademark of the National Football League in the United States.) The term occurs once for an object acquired this month, resulting in a rank increase of 12, and once with an object acquired two months ago, resulting in a rank increase of 10. Together the rank increase results in a total ranking order calculation of 22. The three objects that are eight months old (legal documents) have a total ranking order calculation of 15. Although in the above example the term "Legal Document" occurs more frequently than the term "NFL®," the acquisition date of each term gives the "NFL®" term an overall higher ranking. It can be appreciated that this example using ranking metric **83** is only illustrative of one method for determining the value of items in an inventory and is not limiting.

Referring again to FIG. **5**, a priority component **82** of prioritization tool **53** is described in further detail. In an exemplary embodiment, priority component **82** is configured to compare the objects in the virtual universe to the value assigned to each of the items within avatar inventory **64** to determine a priority of each of the objects in the virtual universe. Specifically, priority component **82** collects object information from areas within the virtual universe both inside and outside of the rendering radius of avatar **38**. Priority component **82** then compares metadata associated with the objects in the virtual universe to the ranked metadata associated with each item in the avatar inventory **64** to determine a priority for each of the objects in the virtual universe.

In one embodiment, when collecting object information, a caching component **84** identifies a first group of objects from the objects in the virtual universe that is outside of the rendering radius of avatar **38**. The first group of objects includes objects in adjacent regions or portions of the virtual universe that avatar **38** is likely to travel to. To make sure that each of the first group of objects is discriminately rendered to the user as quickly as possible upon entrance to an adjacent area of the virtual universe outside of the rendering radius of avatar **38**, the second group of objects is pre-fetched by caching component **84**.

Caching component **84** downloads and caches to a cache, such as cache **45**, the first group of objects based on the priority assigned to each of the first group of objects in the virtual universe. For example, consider the situation in which avatar **38** is walking through a commercial area within a virtual region, such as shopping mall **34** depicted in FIG. **2**. Caching component **84** analyzes the objects just outside of the rendering radius of the avatar. In this example, the next three stores (not shown) in the shopping mall to be displayed to the avatar **38** may be a music store, a bookstore, and a jewelry store. All of the objects in the shopping mall are analyzed and compared to the items in avatar inventory **64** to determine which of the stores is most likely to be of interest to the avatar. If the inventory metadata in avatar inventory **64** indicates that avatar **38** is interested in reading, the objects associated with the bookstore are downloaded by caching component **84** and delivered to cache **45**. Should avatar **38** move within the virtual universe such that the music store, the bookstore and the jewelry store are now within the avatar's rendering radius, the objects associated with the bookstore are rendered prior to the objects associated with the music store and the jewelry store.

In another embodiment, caching component **84** may be augmented to include a popularity component **85**, which caches popular objects. In this embodiment, metadata for the most popular objects in the virtual universe are analyzed and compared to the avatar's ranked inventory items. The most popular items that are also highly ranked by the value component **80** are downloaded and cached for potential later use. The virtual universe may determine the most popular objects using any known analytics. For example, the most popular objects may be the objects that are most rendered, most placed in inventory, or most placed in regions.

In another embodiment, caching component **84** includes a cache expiration component **87**, which expires objects that are of least interest to the user. When an object in cache **45** must be expire, due to cache size constraints, the object(s) in cache **45** that contain metadata terms without an associated ranking, or a lower ranking as determined by value component **80**, are expired before objects with higher ranking metadata terms.

Further, during operation, avatar **38** may travel to a virtual region or area within the virtual universe containing no previously cached objects associated with it, such as in the event of a teleport. In this case, objects that are currently around avatar **38** must be downloaded and rendered immediately to provide an optimal viewing experience. A downloading component **86** queries the virtual universe to identify a second group of objects from the objects in the virtual universe that are inside of the rendering radius of avatar **38**. Downloading component **86** downloads the second group of objects based on the priority of each of the second group of objects in the virtual universe. Unlike the first group of objects, the second group of objects is not sent to cache **45**. Instead, each of the first group of objects is immediately rendered based on the relative priority of each of the second group of objects. Objects corresponding to items in avatar inventory **64** with a higher value are given priority and downloaded prior to objects corresponding to items with a lower value.

In one example, avatar **38** may wish to teleport to a new virtual region, for example, a bookstore. Assuming that the avatar has never visited the bookstore, cache **45** will contain no pre-cached objects corresponding to the bookstore. Therefore, all of the objects that make up the bookstore must be

downloaded directly from a server. The objects corresponding to inventory items with a higher value are downloaded prior to the objects corresponding to items with a lower value. To accomplish this, the object metadata within the bookstore is compared to the previously computed ranking of items in avatar inventory **64**. Books that are of more interest to avatar **38** are downloaded and rendered before books that are of less interest to avatar **38**.

As shown in FIG. **5**, prioritization tool **53** further comprises a rendering component **88** configured to render the objects in the virtual universe based on the priority of each of the objects in the virtual universe. In particular, rendering component **88** renders at least one of the following: the first group of objects from set of objects in the virtual universe within cache **45**, or the second group of objects from the set of objects in the virtual universe. As described above, during operation, objects that are both inside and outside of the rendering radius of avatar **38** are compared to the previously computed ranking of items in avatar inventory **64** to render objects based on each object's priority. If a plurality of objects is to be rendered, as is typically the case, the object(s) with higher priority are rendered before those objects with lower ranking or no metadata terms. This improves the user experience, as the most likely to be used objects are rendered prior to less likely to be used objects.

In another embodiment of this invention, prioritization tool **53** is used as a service to charge fees for prioritized rendering of objects in the virtual universe. Specifically, prioritization tool comprises a transaction component **90** configured to charge a rendering fee for rendering the objects in the virtual universe based on the priority of each of the objects in the virtual universe. In this embodiment, the provider of the virtual universe or a third party service provider could offer this prioritized rendering as a service by performing the functionalities described herein on a subscription and/or fee basis. In this case, the provider of the virtual universe or the third party service provider can create, deploy, maintain, support, etc., prioritization tool **53** that performs the processes described in the invention. In return, the virtual universe or the third party service provider can receive payment from the virtual universe residents via universe economy management component **70** and commercial transaction management component **72** (FIG. **4**).

In still another embodiment, the methodologies disclosed herein can be used within a computer system to provide prioritized rendering of objects in the virtual universe. In this case, prioritization tool **53** can be provided, and one or more systems for performing the processes described in the invention can be obtained and deployed to a computer infrastructure. To this extent, the deployment can comprise one or more of (1) installing program code on a computing device, such as a computer system, from a computer-readable medium; (2) adding one or more computing devices to the infrastructure; and (3) incorporating and/or modifying one or more existing systems of the infrastructure to enable the infrastructure to perform the process actions of the invention.

FIG. **6** shows a schematic of an exemplary computing environment in which elements of the networking environment shown in FIG. **1** may operate. The exemplary computing environment **100** is only one example of a suitable computing environment and is not intended to suggest any limitation as to the scope of use or functionality of the approach described herein. Neither should computing environment **100** be interpreted as having any dependency or requirement relating to any one or combination of components illustrated in FIG. **6**.

Computing environment **100** comprises a computer **102**, which is operational with numerous other general purpose or special purpose computing system environments or configurations. Examples of well known computing systems, environments, and/or configurations that may be suitable for use with computer **102** include, but are not limited to, personal computers, server computers, thin clients, thick clients, handheld or laptop devices, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network PCs, minicomputers, mainframe computers, distributed computing environments that include any of the above systems or devices, and the like.

Computer **102** may be described in the general context of computer-executable instructions, such as program modules, being executed by a computer. Generally, program modules include routines, programs, objects, components, logic, data structures, and so on that perform particular tasks or implements particular abstract data types. Computer **102** may be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote computer storage media including memory storage devices.

As shown in FIG. **6**, computer **102** in computing environment **100** is shown in the form of a general-purpose computing device. The components of computer **102** may include, but are not limited to, one or more processors or processing units **104**, a system memory **106**, and a bus **108** that couples various system components including system memory **106** to processor **104**.

Bus **108** represents one or more of any of several types of bus structures, including a memory bus or memory controller, a peripheral bus, an accelerated graphics port, and a processor or local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnects (PCI) bus.

Computer **102** typically includes a variety of computer readable media. Such media may be any available media that is accessible by computer **102**, and it includes both volatile and non-volatile media, removable and non-removable media.

In FIG. **6**, system memory **106** includes computer readable media in the form of volatile memory, such as random access memory (RAM) **110**, and/or non-volatile memory, such as ROM **112**. A BIOS **114** containing the basic routines that help to transfer information between elements within computer **102**, such as during start-up, is stored in ROM **112**. RAM **110** typically contains data and/or program modules that are immediately accessible to and/or presently operated on by processor **104**.

Computer **102** may further include other removable/non-removable, volatile/non-volatile computer storage media. By way of example only, FIG. **6** illustrates a hard disk drive **116** for reading from and writing to a non-removable, non-volatile magnetic media (not shown and typically called a "hard drive"), a magnetic disk drive **188** for reading from and writing to a removable, non-volatile magnetic disk **120** (e.g., a "floppy disk"), and an optical disk drive **122** for reading from or writing to a removable, non-volatile optical disk **124** such as a CD-ROM, DVD-ROM or other optical media. Hard disk drive **116**, magnetic disk drive **118**, and optical disk drive **122** are each connected to bus **108** by one or more data media interfaces **126**.

The drives and their associated computer-readable media provide nonvolatile storage of computer readable instruc-

tions, data structures, program modules, and other data for computer **102**. Although the exemplary environment described herein employs a hard disk **116**, a removable magnetic disk **188** and a removable optical disk **122**, it should be appreciated by those skilled in the art that other types of computer readable media which can store data that is accessible by a computer, such as magnetic cassettes, flash memory cards, digital video disks, RAMs, ROM, and the like, may also be used in the exemplary operating environment.

A number of program modules may be stored on hard disk **116**, magnetic disk **120**, optical disk **122**, ROM **112**, or RAM **110**, including, by way of example, and not limitation, an operating system **128**, one or more application programs **130**, other program modules **132**, and program data **134**. Each of the operating system **128**, one or more application programs **130** other program modules **132**, and program data **134** or some combination thereof, may include an implementation of the networking environment **10** of FIG. **1** including server array **14** and virtual universe client **24**. In one embodiment, the one or more application programs **130** include components of prioritization tool **53** such as value component **80**, priority component **82**, caching component **84**, downloading component **86**, rendering component **88**, and transaction component **90**.

The one or more program modules **130** carry out the methodologies disclosed herein, as shown in FIG. **7**. According to one embodiment, in step S**1**, a value is assigned to each of the set of items within an inventory of an avatar. In S**2**, a set of objects in the VU is compared to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the VU. In S**3**, a first group of objects from the set of objects in the VU is downloaded and cached to a cache, each of the first group of objects being outside of a rendering radius of the avatar. In S**4**, each of the second group of objects from the set of objects in the VU is downloaded, each of the second group of objects being inside the rendering radius of the avatar. In S**5**, each of the set of objects in the VU is rendered based on the priority of each of the set of objects in the VU.

The flowchart of FIG. **7** illustrates the architecture, functionality, and operation of possible implementations of systems, methods and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart may represent a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that, in some alternative implementations, the functions noted in the blocks may occur out of the order noted in the figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently. It will also be noted that each block of flowchart illustration can be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and computer instructions

Referring back to FIG. **6**, a user may enter commands and information into computer **102** through optional input devices such as a keyboard **136** and a pointing device **138** (such as a "mouse"). Other input devices (not shown) may include a microphone, joystick, game pad, satellite dish, serial port, scanner, camera, or the like. These and other input devices are connected to the processor unit **104** through a user input interface **140** that is coupled to bus **108**, but may be connected by other interface and bus structures, such as a parallel port, game port, or a universal serial bus (USB).

An optional monitor **142** or other type of display device is also connected to bus **108** via an interface, such as a video adapter **144**. In addition to the monitor, personal computers typically include other peripheral output devices (not shown), such as speakers and printers, which may be connected through output peripheral interface **146**.

Computer **102** may operate in a networked environment using logical connections to one or more remote computers, such as a remote server/computer **148**. Remote computer **148** may include many or all of the elements and features described herein relative to computer **102**.

Logical connections shown in FIG. **6** are a local area network (LAN) **150** and a general wide area network (WAN) **152**. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets, and the Internet. When used in a LAN networking environment, the computer **102** is connected to LAN **150** via network interface or adapter **154**. When used in a WAN networking environment, the computer typically includes a modem **156** or other means for establishing communications over the WAN **152**. The modem, which may be internal or external, may be connected to the system bus **108** via the user input interface **140** or other appropriate mechanism.

In a networked environment, program modules depicted relative to the personal computer **102**, or portions thereof, may be stored in a remote memory storage device. By way of example, and not limitation, FIG. **6** illustrates remote application programs **158** as residing on a memory device of remote computer **148**. It will be appreciated that the network connections shown and described are exemplary and other means of establishing a communications link between the computers may be used.

An implementation of an exemplary computer **102** may be stored on or transmitted across some form of computer readable media. Computer readable media can be any available media that can be accessed by a computer. By way of example, and not limitation, computer readable media may comprise "computer storage media" and "communications media."

"Computer storage media" include volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules, or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by a computer.

"Communication media" typically embodies computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as carrier wave or other transport mechanism. Communication media also includes any information delivery media.

The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared, and other wireless media. Combinations of any of the above are also included within the scope of computer readable media.

It is apparent that there has been provided with this invention an approach for prioritized rendering of objects in a virtual universe. While the invention has been particularly shown and described in conjunction with a preferred embodiment thereof, it will be appreciated that variations and modifications will occur to those skilled in the art. Therefore, it is

to be understood that the appended claims are intended to cover all such modifications and changes that fall within the true spirit of the invention.

What is claimed is:

1. A method for prioritized rendering of objects in a virtual universe, comprising:

analyzing a set of metadata descriptors associated with a set of items within an inventory of an avatar;

ranking each of the set of metadata descriptors based on a number of occurrences of each of the set of metadata descriptors and an acquisition date of one or more of the set of items within the inventory of the avatar associated with each of the set of metadata descriptors;

assigning a value to each of the set of items within the inventory of an avatar based on the ranking of each of the set of metadata descriptors;

comparing a set of objects in a commercial area of the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the commercial area of the virtual universe, the commercial area having a plurality of virtual retail stores;

assigning a priority to each of the plurality of virtual stores in the commercial area based on the priority of each of the set of objects in the virtual universe;

determining a rendering radius of the avatar traversing the commercial area of the virtual universe;

identifying a set of virtual stores from the plurality of virtual stores in the virtual universe that is outside the rendering radius of the avatar;

downloading and caching within a cache, each of the objects from the set of virtual stores from the plurality of virtual stores in the virtual universe that are outside the rendering radius of the avatar based on the relative priorities of each of the set of the plurality of virtual stores in the virtual universe that are outside the rendering radius of the avatar, wherein each of the objects from a first virtual store of the set of virtual stores from the plurality of virtual stores that is outside of the rendering radius of the avatar are downloaded and cached within the cache prior to any objects from a second virtual store of the set of virtual stores from the plurality of virtual stores that is outside the rendering radius of the avatar, the first virtual store having a higher priority than the second virtual store; and

rendering the set of virtual stores in the virtual universe based on the priority of each of the set of virtual stores in the virtual universe.

2. The method according to claim **1** further comprising:

identifying a second group of objects from the set of objects in the virtual universe that is inside the rendering radius of the avatar; and

downloading each of the second group of objects from the set of objects in the virtual universe based on the priority of each of the second group of objects from the set of objects in the virtual universe.

3. The method according to claim **2**, the rendering comprising rendering at least one of the following: a first group of objects from the set of objects in the virtual universe within the cache, or the second group of objects from the set of objects in the virtual universe.

4. The method according to claim **1** further comprising charging a rendering fee for rendering the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

5. A computer system for providing prioritized rendering of objects in a virtual universe, comprising:

at least one processing unit;

memory operably associated with the at least one processing unit; and

a prioritization tool storable in memory and executable by the at least one processing unit, the prioritization tool comprising:

a value component configured to:

analyze a set of metadata descriptors associated with a set of items within an inventory of an avatar;

rank each of the set of metadata descriptors based on a number of occurrences of each of the set of metadata descriptors and an acquisition date of an item from the set of items associated with each of the set of metadata descriptors; and

assign a value to each of the set of items within the inventory of an avatar based on the ranking of each of the set of metadata descriptors:

a priority component configured to compare a set of objects in a commercial area of the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the commercial area of the virtual universe, the commercial area having a plurality of virtual retail stores;

a caching component configured to:

assign a priority to each of the plurality of virtual stores in the commercial area based on the priority of each of the set of objects in the virtual universe;

determine a rendering radius of the avatar traversing the commercial area of the virtual universe

identify a set of virtual stores from the plurality of virtual stores in the virtual universe that is outside the rendering radius of the avatar; and

download and cache within a cache, each of the objects from the set of virtual stores from the plurality of virtual stores in the virtual universe that are outside the rendering radius of the avatar based on the relative priorities of each of the set of the plurality of virtual stores in the virtual universe that are outside the rendering radius of the avatar, wherein each of the objects from a first virtual store of the set of virtual stores from the plurality of virtual stores that is outside of the rendering radius of the avatar are downloaded and cached within the cache prior to any objects from a second virtual store of the set of virtual stores from the plurality of virtual stores that is outside the rendering radius of the avatar, the first virtual store having a higher priority than the second virtual store; and

a rendering component configured to render the set of virtual stores in the virtual universe based on the priority of each of the set of virtual stores in the virtual universe.

6. The prioritization tool according to claim **5** further comprising:

a downloading component configured to:

identify a second group of objects from the set of objects in the virtual universe that is inside the rendering radius of the avatar; and

download each of the second group of objects from the set of objects based on the priority of each of the second group of objects from the set of objects in the virtual universe.

7. The prioritization tool according to claim **6**, the rendering component configured to render at least one of the following: a first group of objects from the set of objects in the

virtual universe within the cache, or the second group of objects from the set of objects in the virtual universe.

8. The prioritization tool of claim **7** further comprising a transaction component configured to charge a rendering fee for rendering the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

9. A computer-readable storage device storing computer instructions, which when executed, enables a computer system to provide prioritized rendering of objects in a virtual universe, the computer instructions comprising:

analyzing a set of metadata descriptors associated with a set of items within an inventory of an avatar;

ranking each of the set of metadata descriptors based on a number of occurrences of each of the set of metadata descriptors and an acquisition date associated with each of the set of metadata descriptors;

assigning a value to each of the set of items within the inventory of an avatar based on the ranking of each of the set of metadata descriptors;

comparing a set of objects in a commercial area of the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the commercial area of the virtual universe, the commercial area having a plurality of virtual retail stores;

assigning a priority to each of the plurality of virtual stores in the commercial area based on the priority of each of the set of objects in the virtual universe;

determining a rendering radius of the avatar traversing the commercial area of the virtual universe;

identifying a set of virtual stores from the plurality of virtual stores in the virtual universe that is outside the rendering radius of the avatar;

downloading and caching within a cache, each of the objects from the set of virtual stores from the plurality of virtual stores in the virtual universe that are outside the rendering radius of the avatar based on the relative priorities of each of the set of the plurality of virtual stores in the virtual universe that are outside the rendering radius of the avatar, wherein each of the objects from a first virtual store of the set of virtual stores from the plurality of virtual stores that is outside of the rendering radius of the avatar are downloaded and cached within the cache prior to any objects from a second virtual store of the set of virtual stores from the plurality of virtual stores that is outside the rendering radius of the avatar, the first virtual store having a higher priority than the second virtual store; and

rendering the set of virtual stores in the virtual universe based on the priority of each of the set of virtual stores in the virtual universe.

10. The computer-readable storage device according to claim **9** further comprising instructions for:

identifying a second group of objects from the set of objects in the virtual universe that is inside the rendering radius of the avatar; and

downloading each of the second group of objects from the set of objects in the virtual universe based on the priority of each of the second group of objects from the set of objects in the virtual universe.

11. The computer-readable storage device according to claim **10** further comprising instructions for rendering at least one of the following: the first group of objects from the set of objects in the virtual universe within the cache, or the second group of objects from the set of objects in the virtual universe.

12. The computer-readable storage device according to claim **9** further comprising instructions for charging a rendering fee for rendering the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

13. A method for deploying a prioritization tool for use in a computer system that provides prioritized rendering of objects in a virtual universe, comprising the computer-implemented steps to:

analyze a set of metadata descriptors associated with a set of items within an inventory of an avatar;

rank each of the set of metadata descriptors based on a number of occurrences of each of the set of metadata descriptors and an acquisition date associated with each of the set of metadata descriptors;

compare a set of objects in a commercial area of the virtual universe to the value assigned to each of the set of items within the inventory of the avatar to determine a priority of each of the set of objects in the commercial area of the virtual universe, the commercial area having a plurality of virtual retail stores;

assign a priority to each of the plurality of virtual stores in the commercial area based on the priority of each of the set of objects in the virtual universe;

determine a rendering radius of the avatar traversing the commercial area of the virtual universe;

identify a set of virtual stores from the plurality of virtual stores in the virtual universe that is outside the rendering radius of the avatar;

download and cache within a cache, each of the objects from the set of virtual stores from the plurality of virtual stores in the virtual universe that are outside the rendering radius of the avatar based on the relative priorities of each of the set of the plurality of virtual stores in the virtual universe that are outside the rendering radius of the avatar, wherein each of the objects from a first virtual store of the set of virtual stores from the plurality of virtual stores that is outside of the rendering radius of the avatar are downloaded and cached within the cache prior to any objects from a second virtual store of the set of virtual stores from the plurality of virtual stores that is outside the rendering radius of the avatar, the first virtual store having a higher priority than the second virtual store; and

render the set of virtual stores in the virtual universe based on the priority of each of the set of virtual stores in the virtual universe.

14. The method according to claim **13**, further comprising the computer-implemented steps to:

identify a second group of objects from the set of objects in the virtual universe that is inside the rendering radius of the avatar; and

download each of the second group of objects from the set of objects in the virtual universe based on the priority of each of the second group of objects from the set of objects in the virtual universe.

15. The method according to claim **13**, further comprising the computer-implemented step to render at least one of the following: a first group of objects from the set of objects in the virtual universe within the cache, or the second group of objects from the set of objects in the virtual universe.

16. The method according to claim **13**, further comprising the computer-implemented step to charge a rendering fee for rendering the set of objects in the virtual universe based on the priority of each of the set of objects in the virtual universe.

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